

**TABLE OF CONTENTS**

<u>Section</u>	<u>Title</u>	<u>Page</u>
<b>CHAPTER 3 DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT AND SYSTEMS .....</b> 3.1-1		
3.1	Conformance with Nuclear Regulatory Commission General Design Criteria.....	3.1-1
	3.1.1 Overall Requirements .....	3.1-1
	3.1.2 Protection by Multiple Fission Product Barriers .....	3.1-4
	3.1.3 Protection and Reactivity Control Systems .....	3.1-11
	3.1.4 Fluid Systems.....	3.1-17
	3.1.5 Reactor Containment .....	3.1-28
	3.1.6 Fuel and Reactivity Control .....	3.1-32
	3.1.7 Combined License Information.....	3.1-35
	3.1.8 References.....	3.1-35
3.2	Classification of Structures, Components, and Systems.....	3.2-1
	3.2.1 Seismic Classification .....	3.2-1
	3.2.1.1 Definitions.....	3.2-1
	3.2.1.2 Classifications .....	3.2-3
	3.2.1.3 Classification of Building Structures.....	3.2-3
	3.2.2 AP1000 Classification System.....	3.2-3
	3.2.2.1 Classification Definitions .....	3.2-4
	3.2.2.2 Application of Classification .....	3.2-4
	3.2.2.3 Equipment Class A.....	3.2-5
	3.2.2.4 Equipment Class B .....	3.2-5
	3.2.2.5 Equipment Class C .....	3.2-6
	3.2.2.6 Equipment Class D.....	3.2-8
	3.2.2.7 Other Equipment Classes .....	3.2-11
	3.2.2.8 Instrumentation and Control Line Interface Criteria.....	3.2-12
	3.2.2.9 Electrical Classifications .....	3.2-12
	3.2.3 Inspection Requirements.....	3.2-12
	3.2.4 Application of AP1000 Safety-Related Equipment and Seismic Classification System.....	3.2-13
	3.2.5 Combined License Information.....	3.2-16
	3.2.6 References.....	3.2-16
3.3	Wind and Tornado Loadings.....	3.3-1
	3.3.1 Wind Loadings.....	3.3-1
	3.3.1.1 Design Wind Velocity .....	3.3-1
	3.3.1.2 Determination of Applied Forces .....	3.3-1
	3.3.2 Tornado Loadings .....	3.3-1
	3.3.2.1 Applicable Design Parameters.....	3.3-2
	3.3.2.2 Determination of Forces on Structures .....	3.3-2
	3.3.2.3 Effect of Failure of Structures or Components Not Designed for Tornado Loads.....	3.3-3
	3.3.2.4 Tornado Loads on the Passive Containment Cooling System Air Baffle.....	3.3-3

**TABLE OF CONTENTS (Cont.)**

<b><u>Section</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
3.4	3.3.3 Combined License Information.....	3.3-4
	3.3.4 References.....	3.3-5
	<b>Water Level (Flood) Design.....</b>	<b>3.4-1</b>
	3.4.1 Flood Protection.....	3.4-1
	3.4.1.1 Flood Protection Measures for Seismic Category I Structures, Systems, and Components.....	3.4-1
	3.4.1.2 Evaluation of Flooding Events .....	3.4-4
	3.4.1.3 Permanent Dewatering System.....	3.4-24
	3.4.2 Analytical and Test Procedures.....	3.4-24
	3.4.3 Combined License Information.....	3.4-24
	3.4.4 References.....	3.4-24
3.5	<b>Missile Protection.....</b>	<b>3.5-1</b>
	3.5.1 Missile Selection and Description.....	3.5-3
	3.5.1.1 Internally Generated Missiles (Outside Containment).....	3.5-3
	3.5.1.2 Internally Generated Missiles (Inside Containment) .....	3.5-8
	3.5.1.3 Turbine Missiles.....	3.5-11
	3.5.1.4 Missiles Generated by Natural Phenomena .....	3.5-11
	3.5.1.5 Missiles Generated by Events Near the Site .....	3.5-12
	3.5.1.6 Aircraft Hazards .....	3.5-12
	3.5.2 Protection from Externally Generated Missiles.....	3.5-12
	3.5.3 Barrier Design Procedures .....	3.5-13
3.5.3.1 Ductility Factors for Steel Structures.....	3.5-15	
3.5.4 Combined License Information.....	3.5-15	
3.5.5 References.....	3.5-16	
3.6	<b>Protection Against the Dynamic Effects Associated with the Postulated Rupture of Piping.....</b>	<b>3.6-1</b>
	3.6.1 Postulated Piping Failures in Fluid Systems Inside and Outside Containment.....	3.6-2
	3.6.1.1 Design Basis.....	3.6-3
	3.6.1.2 Description .....	3.6-6
	3.6.1.3 Safety Evaluation .....	3.6-8
	3.6.2 Determination of Break Locations and Dynamic Effects Associated with the Postulated Rupture of Piping .....	3.6-11
	3.6.2.1 Criteria Used to Define High- and Moderate-Energy Break and Crack Locations and Configurations .....	3.6-11
	3.6.2.2 Analytical Methods to Define Jet Thrust Forcing Functions and Response Models .....	3.6-19
	3.6.2.3 Dynamic Analysis Methods to Verify Integrity and Operability .....	3.6-21
	3.6.2.4 Protective Assembly Design Criteria.....	3.6-25
3.6.2.5 Evaluation of Dynamic Effects of Pipe Ruptures .....	3.6-25	
3.6.2.6 Evaluation of Flooding Effects from Pipe Failures .....	3.6-28	

**TABLE OF CONTENTS (Cont.)**

<u>Section</u>	<u>Title</u>	<u>Page</u>
	3.6.2.7 Evaluation of Spray Effects from High- and Moderate-Energy Through-Wall Cracks .....	3.6-28
3.6.3	3.6.3 Leak-before-Break Evaluation Procedures.....	3.6-29
	3.6.3.1 Application of Mechanistic Pipe Break Criteria.....	3.6-30
	3.6.3.2 Design Criteria for Leak-before-Break .....	3.6-31
	3.6.3.3 Analysis Methods and Criteria .....	3.6-33
	3.6.3.4 Documentation of Leak-before-Break Evaluations.....	3.6-34
3.6.4	3.6.4 Combined License Information.....	3.6-35
	3.6.4.1 Pipe Break Hazard Analysis .....	3.6-35
	3.6.4.2 Leak-before-Break Evaluation of As-Designed Piping .....	3.6-36
	3.6.4.3 Leak-before-Break Evaluation of As-Built Piping .....	3.6-36
	3.6.4.4 Primary System Inspection Program for Leak-before-Break Piping .....	3.6-36
3.6.5	3.6.5 References.....	3.6-36
3.7	<b>Seismic Design.....</b>	<b>3.7-1</b>
3.7.1	3.7.1 Seismic Input .....	3.7-1
	3.7.1.1 Design Response Spectra .....	3.7-1
	3.7.1.2 Design Time History .....	3.7-3
	3.7.1.3 Critical Damping Values .....	3.7-5
	3.7.1.4 Supporting Media for Seismic Category I Structures .....	3.7-6
3.7.2	3.7.2 Seismic System Analysis .....	3.7-7
	3.7.2.1 Seismic Analysis Methods.....	3.7-8
	3.7.2.2 Natural Frequencies and Response Loads .....	3.7-10
	3.7.2.3 Procedure Used for Modeling .....	3.7-10
	3.7.2.4 Soil-Structure Interaction .....	3.7-14
	3.7.2.5 Development of Floor Response Spectra.....	3.7-15
	3.7.2.6 Three Components of Earthquake Motion .....	3.7-15
	3.7.2.7 Combination of Modal Responses.....	3.7-17
	3.7.2.8 Interaction of Seismic Category II and Nonseismic Structures with Seismic Category I Structures, Systems, or Components .....	3.7-17
	3.7.2.9 Effects of Parameter Variations on Floor Response Spectra.....	3.7-20
	3.7.2.10 Use of Constant Vertical Static Factors .....	3.7-21
	3.7.2.11 Method Used to Account for Torsional Effects.....	3.7-21
	3.7.2.12 Methods for Seismic Analysis of Dams.....	3.7-21
	3.7.2.13 Determination of Seismic Category I Structure Overturning Moments .....	3.7-21
	3.7.2.14 Analysis Procedure for Damping.....	3.7-22
3.7.3	3.7.3 Seismic Subsystem Analysis .....	3.7-22
	3.7.3.1 Seismic Analysis Methods.....	3.7-22
	3.7.3.2 Determination of Number of Earthquake Cycles.....	3.7-22
	3.7.3.3 Procedure Used for Modeling .....	3.7-23
	3.7.3.4 Basis for Selection of Frequencies .....	3.7-24
	3.7.3.5 Equivalent Static Load Method of Analysis .....	3.7-24
	3.7.3.6 Three Components of Earthquake Motion .....	3.7-25

**TABLE OF CONTENTS (Cont.)**

<u>Section</u>	<u>Title</u>	<u>Page</u>
	3.7.3.7 Combination of Modal Responses.....	3.7-26
	3.7.3.8 Analytical Procedure for Piping .....	3.7-30
	3.7.3.9 Combination of Support Responses .....	3.7-35
	3.7.3.10 Vertical Static Factors .....	3.7-38
	3.7.3.11 Torsional Effects of Eccentric Masses.....	3.7-38
	3.7.3.12 Seismic Category I Buried Piping Systems and Tunnels.....	3.7-38
	3.7.3.13 Interaction of Other Systems with Seismic Category I Systems .....	3.7-38
	3.7.3.14 Seismic Analyses for Reactor Internals .....	3.7-44
	3.7.3.15 Analysis Procedure for Damping.....	3.7-44
	3.7.3.16 Analysis of Seismic Category I Tanks .....	3.7-45
	3.7.3.17 Time History Analysis of Piping Systems .....	3.7-45
3.7.4	Seismic Instrumentation.....	3.7-46
	3.7.4.1 Comparison with Regulatory Guide 1.12 .....	3.7-46
	3.7.4.2 Location and Description of Instrumentation .....	3.7-47
	3.7.4.3 Control Room Operator Notification.....	3.7-48
	3.7.4.4 Comparison of Measured and Predicted Responses .....	3.7-48
	3.7.4.5 Tests and Inspections.....	3.7-49
3.7.5	Combined License Information.....	3.7-49
	3.7.5.1 Seismic Analysis of Dams .....	3.7-49
	3.7.5.2 Post-Earthquake Procedures .....	3.7-49
	3.7.5.3 Seismic Interaction Review .....	3.7-49
	3.7.5.4 Reconciliation of Seismic Analyses of Nuclear Island Structures .....	3.7-49
	3.7.5.5 Free Field Acceleration Sensor.....	3.7-50
3.7.6	References.....	3.7-50
3.8	<b>Design of Category I Structures .....</b>	<b>3.8-1</b>
3.8.1	Concrete Containment .....	3.8-1
3.8.2	Steel Containment.....	3.8-1
	3.8.2.1 Description of the Containment.....	3.8-1
	3.8.2.2 Applicable Codes, Standards, and Specifications.....	3.8-5
	3.8.2.3 Loads and Load Combinations .....	3.8-5
	3.8.2.4 Design and Analysis Procedures .....	3.8-7
	3.8.2.5 Structural Criteria.....	3.8-16
	3.8.2.6 Materials, Quality Control, and Special Construction Techniques .....	3.8-17
	3.8.2.7 Testing and In-Service Inspection Requirements .....	3.8-18
3.8.3	Concrete and Steel Internal Structures of Steel Containment .....	3.8-18
	3.8.3.1 Description of the Containment Internal Structures .....	3.8-18
	3.8.3.2 Applicable Codes, Standards, and Specifications.....	3.8-22
	3.8.3.3 Loads and Load Combinations.....	3.8-23
	3.8.3.4 Analysis Procedures .....	3.8-25
	3.8.3.5 Design Procedures and Acceptance Criteria.....	3.8-32

**TABLE OF CONTENTS (Cont.)**

<b><u>Section</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
	3.8.3.6 Materials, Quality Control, and Special Construction Techniques .....	3.8-40
	3.8.3.7 In-Service Testing and Inspection Requirements .....	3.8-41
	3.8.3.8 Construction Inspection.....	3.8-41
3.8.4	3.8.4 Other Category I Structures.....	3.8-42
	3.8.4.1 Description of the Structures .....	3.8-42
	3.8.4.2 Applicable Codes, Standards, and Specifications.....	3.8-48
	3.8.4.3 Loads and Load Combinations.....	3.8-49
	3.8.4.4 Design and Analysis Procedures .....	3.8-51
	3.8.4.5 Structural Criteria .....	3.8-57
	3.8.4.6 Materials, Quality Control, and Special Construction Techniques .....	3.8-61
	3.8.4.7 Testing and In-Service Inspection Requirements .....	3.8-63
	3.8.4.8 Construction Inspection.....	3.8-64
3.8.5	3.8.5 Foundations.....	3.8-65
	3.8.5.1 Description of the Foundations.....	3.8-65
	3.8.5.2 Applicable Codes, Standards, and Specifications.....	3.8-65
	3.8.5.3 Loads and Load Combinations.....	3.8-65
	3.8.5.4 Design and Analysis Procedures .....	3.8-66
	3.8.5.5 Structural Criteria .....	3.8-72
	3.8.5.6 Materials, Quality Control, and Special Construction Techniques .....	3.8-75
	3.8.5.7 In-Service Testing and Inspection Requirements .....	3.8-75
	3.8.5.8 Construction Inspection.....	3.8-75
3.8.6	3.8.6 Combined License Information.....	3.8-76
	3.8.6.1 Containment Vessel Design Adjacent to Large Penetrations .....	3.8-76
	3.8.6.2 Passive Containment Cooling System Water Storage Tank Examination .....	3.8-76
	3.8.6.3 As-Built Summary Report .....	3.8-76
	3.8.6.4 In-Service Inspection of Containment Vessel.....	3.8-76
	3.8.6.5 Structures Inspection Program.....	3.8-76
	3.8.6.6 Construction Procedures Program .....	3.8-76
3.8.7	3.8.7 References.....	3.8-77
3.9	<b>Mechanical Systems and Components .....</b>	<b>3.9-1</b>
3.9.1	3.9.1 Special Topics for Mechanical Components .....	3.9-1
	3.9.1.1 Design Transients .....	3.9-1
	3.9.1.2 Computer Programs Used in Analyses .....	3.9-26
	3.9.1.3 Experimental Stress Analysis .....	3.9-27
	3.9.1.4 Considerations for the Evaluation of the Faulted Conditions .....	3.9-27
	3.9.1.5 Module Interaction, Coupling, and Other Issues .....	3.9-27

**TABLE OF CONTENTS (Cont.)**

<b><u>Section</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
3.9.2	Dynamic Testing and Analysis .....	3.9-28
3.9.2.1	Piping Vibration, Thermal Expansion, and Dynamic Effects .....	3.9-28
3.9.2.2	Seismic Qualification Testing of Safety-Related Mechanical Equipment.....	3.9-31
3.9.2.3	Dynamic Response Analysis of Reactor Internals under Operational Flow Transients and Steady-State Conditions ....	3.9-32
3.9.2.4	Pre-operational Flow-Induced Vibration Testing of Reactor Internals .....	3.9-36
3.9.2.5	Dynamic System Analysis of the Reactor Internals Under Faulted Conditions .....	3.9-38
3.9.2.6	Correlation of Reactor Internals Vibration Tests with the Analytical Results .....	3.9-43
3.9.3	ASME Code Classes 1, 2, and 3 Components, Component Supports, and Core Support Structures .....	3.9-43
3.9.3.1	Loading Combinations, Design Transients, and Stress Limits .....	3.9-44
3.9.3.2	Pump and Valve Operability Assurance.....	3.9-59
3.9.3.3	Design and Installation Criteria of Class 1, 2, and 3 Pressure Relieving Devices .....	3.9-61
3.9.3.4	Component and Piping Supports.....	3.9-63
3.9.3.5	Instrumentation Line Supports .....	3.9-68
3.9.4	Control Rod Drive System (CRDS).....	3.9-68
3.9.4.1	Descriptive Information of CRDS .....	3.9-68
3.9.4.2	Applicable CRDS Design Specifications .....	3.9-74
3.9.4.3	Design Loads, Stress Limits, and Allowable Deformations.....	3.9-77
3.9.4.4	Control Rod Drive Mechanism Performance Assurance Program .....	3.9-78
3.9.5	Reactor Pressure Vessel Internals .....	3.9-78
3.9.5.1	Design Arrangements .....	3.9-78
3.9.5.2	Design Loading Conditions .....	3.9-81
3.9.5.3	Design Bases .....	3.9-82
3.9.6	Inservice Testing of Pumps and Valves .....	3.9-84
3.9.6.1	Inservice Testing of Pumps .....	3.9-85
3.9.6.2	Inservice Testing of Valves .....	3.9-86
3.9.6.3	Relief Requests.....	3.9-93
3.9.7	Integrated Head Package.....	3.9-93
3.9.7.1	Design Bases .....	3.9-93
3.9.7.2	Design Description .....	3.9-94
3.9.7.3	Design Evaluation .....	3.9-96
3.9.7.4	Inspection and Testing Requirements.....	3.9-97

**TABLE OF CONTENTS (Cont.)**

<b><u>Section</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
3.9.8	Combined License Information.....	3.9-97
3.9.8.1	Reactor Internals Vibration Assessment and Predicted Response .....	3.9-97
3.9.8.2	Design Specifications and Reports .....	3.9-97
3.9.8.3	Snubber Operability Testing.....	3.9-98
3.9.8.4	Valve Inservice Testing.....	3.9-98
3.9.8.5	Surge Line Thermal Monitoring.....	3.9-98
3.9.8.6	Piping Benchmark Program .....	3.9-98
3.9.8.7	As-Designed Piping Analysis.....	3.9-99
3.9.9	References.....	3.9-99
3.10	<b>Seismic and Dynamic Qualification of Seismic Category I Mechanical and Electrical Equipment.....</b>	<b>3.10-1</b>
3.10.1	Seismic and Dynamic Qualification Criteria.....	3.10-2
3.10.1.1	Qualification Standards .....	3.10-2
3.10.1.2	Performance Requirements for Seismic Qualification.....	3.10-2
3.10.1.3	Performance Criteria .....	3.10-3
3.10.2	Methods and Procedures for Qualifying Electrical Equipment, Instrumentation, and Mechanical Components .....	3.10-3
3.10.2.1	Seismic Qualification of Instrumentation and Electrical Equipment .....	3.10-4
3.10.2.2	Seismic and Operability Qualification of Active Mechanical Equipment.....	3.10-5
3.10.2.3	Valve Operator Qualification .....	3.10-7
3.10.2.4	Seismic Qualification of Other Seismic Category I Mechanical Equipment.....	3.10-7
3.10.3	Method and Procedures for Qualifying Supports of Electrical Equipment, Instrumentation, and Mechanical Components.....	3.10-7
3.10.4	Documentation.....	3.10-7
3.10.5	Standard Review Plan Evaluation.....	3.10-8
3.10.6	Combined License Information Item on Experienced-Based Qualification .....	3.10-8
3.10.7	References.....	3.10-8
3.11	<b>Environmental Qualification of Mechanical and Electrical Equipment .....</b>	<b>3.11-1</b>
3.11.1	Equipment Identification and Environmental Conditions .....	3.11-1
3.11.1.1	Equipment Identification .....	3.11-1
3.11.1.2	Definition of Environmental Conditions .....	3.11-1
3.11.1.3	Equipment Operability Times .....	3.11-3
3.11.1.4	Standard Review Plan Evaluation .....	3.11-3
3.11.2	Qualification Tests and Analysis.....	3.11-3
3.11.2.1	Environmental Qualification of Electrical Equipment.....	3.11-3
3.11.2.2	Environmental Qualification of Mechanical Equipment .....	3.11-4
3.11.3	Loss of Ventilation.....	3.11-4
3.11.4	Estimated Radiation and Chemical Environment.....	3.11-5
3.11.5	Combined License Information Item for Equipment Qualification File.....	3.11-5
3.11.6	References.....	3.11-5

**TABLE OF CONTENTS (Cont.)**

<u>Section</u>	<u>Title</u>	<u>Page</u>
<b>APPENDIX 3A HVAC DUCTS AND DUCT SUPPORTS.....</b> 3A-1		
3A.1	Codes and Standards .....	3A-1
3A.2	Loads and Load Combinations.....	3A-1
	3A.2.1 Loads .....	3A-1
	3A.2.1.1 Dead Load (D).....	3A-1
	3A.2.1.2 Construction Live Load (L).....	3A-1
	3A.2.1.3 Pressure (P) .....	3A-2
	3A.2.1.4 Safe Shutdown Earthquake ( $E_s$ ) .....	3A-2
	3A.2.1.5 Wind Loads (W).....	3A-2
	3A.2.1.6 Tornado Loads ( $W_t$ ) .....	3A-2
	3A.2.1.7 External Pressure Differential Loads ( $P_A$ ) .....	3A-2
	3A.2.1.8 Thermal ( $T_0/T_A$ ).....	3A-2
	3A.2.2 Load Combinations.....	3A-2
3A.3	Analysis and Design.....	3A-3
	3A.3.1 Response Due to Seismic Loads .....	3A-3
	3A.3.2 Deflection Criteria .....	3A-3
	3A.3.3 Relative Movement.....	3A-3
	3A.3.4 Allowable Stresses .....	3A-4
	3A.3.5 Connections .....	3A-4
<b>APPENDIX 3B LEAK-BEFORE-BREAK EVALUATION OF THE AP1000 PIPING.....</b> 3B-1		
3B.1	Leak-before-Break Criteria for AP1000 Piping.....	3B-2
3B.2	Potential Failure Mechanisms for AP1000 Piping .....	3B-2
	3B.2.1 Erosion-Corrosion Induced Wall Thinning.....	3B-2
	3B.2.2 Stress Corrosion Cracking .....	3B-3
	3B.2.3 Water Hammer.....	3B-5
	3B.2.4 Fatigue .....	3B-6
	3B.2.5 Thermal Aging.....	3B-7
	3B.2.6 Thermal Stratification .....	3B-7
	3B.2.7 Other Mechanisms .....	3B-9
3B.3	Leak-before-Break Bounding Analysis .....	3B-9
	3B.3.1 Procedure for Stainless Steel Piping .....	3B-10
	3B.3.1.1 Pipe Geometry, Material and Operating Conditions.....	3B-10
	3B.3.1.2 Pipe Physical Properties .....	3B-10
	3B.3.1.3 Low Normal Stress Case (Case 1) .....	3B-11
	3B.3.1.4 High Normal Stress Case (Case 2) .....	3B-11
	3B.3.1.5 Develop the Bounding Analysis Curve .....	3B-12
	3B.3.2 Procedure for Non-stainless Steel Piping .....	3B-12
	3B.3.2.1 Pipe Geometry, Material and Operating Conditions.....	3B-12
	3B.3.2.2 Calculations Steps .....	3B-12
	3B.3.2.3 Low Normal Stress Case (Case 1) .....	3B-13
	3B.3.2.4 High Normal Stress Case (Case 2) .....	3B-13
	3B.3.2.5 Develop the Bounding Analysis Curve .....	3B-14

**TABLE OF CONTENTS (Cont.)**

<u>Section</u>	<u>Title</u>	<u>Page</u>
3B.3.3	Evaluation of Piping System Using Bounding Analysis Curves .....	3B-14
3B.3.3.1	Calculation of Stresses .....	3B-14
3B.3.3.2	Normal Loads .....	3B-15
3B.3.3.3	Maximum Loads .....	3B-15
3B.3.3.4	Bounding Analysis Curve Comparison – LBB Criteria.....	3B-16
3B.3.4	Bounding Analysis Results .....	3B-16
3B.4	Differences in Leak-before-Break Analysis for Stainless Steel and Ferritic Steel Pipe .....	3B-16
3B.5	Differences in Inspection Criteria for Class 1, 2, and 3 Systems.....	3B-16
3B.6	Differences in Fabrication Requirements of ASME Class 1, Class 2, and Class 3 Piping .....	3B-17
3B.7	Sensitivity Study for the Constraint Effect on LBB .....	3B-17
3B.8	References .....	3B-17
<b>APPENDIX 3C REACTOR COOLANT LOOP ANALYSIS METHODS.....</b>		<b>3C-1</b>
3C.1	Reactor Coolant Loop Model Description.....	3C-1
3C.1.1	Steam Generator Model .....	3C-1
3C.1.1.1	Steam Generator Mass and Geometrical Model .....	3C-1
3C.1.1.2	Steam Generator Supports .....	3C-1
3C.1.2	Reactor Coolant Pump Model.....	3C-2
3C.1.2.1	Static Model .....	3C-2
3C.1.2.2	Seismic Model.....	3C-2
3C.1.2.3	Reactor Coolant Pump Supports .....	3C-2
3C.1.3	Reactor Pressure Vessel Model.....	3C-2
3C.1.3.1	Mass and Geometrical Model.....	3C-2
3C.1.3.2	Reactor Pressure Vessel Supports .....	3C-2
3C.1.4	Containment Interior Building Structure Model .....	3C-2
3C.1.5	Reactor Coolant Loop Piping Model .....	3C-3
3C.2	Design Requirements .....	3C-3
3C.3	Static Analyses .....	3C-3
3C.3.1	Deadweight Analysis .....	3C-3
3C.3.2	Internal Pressure Analysis .....	3C-4
3C.3.3	Thermal Expansion Analysis .....	3C-4
3C.4	Seismic Analyses.....	3C-4
3C.5	Reactor Coolant Loop Piping Stresses .....	3C-5
3C.6	Description of Computer Programs.....	3C-5
<b>APPENDIX 3D METHODOLOGY FOR QUALIFYING AP1000 SAFETY-RELATED ELECTRICAL AND MECHANICAL EQUIPMENT .....</b>		<b>3D-1</b>
3D.1	Purpose.....	3D-2
3D.2	Scope.....	3D-2
3D.3	Introduction.....	3D-3

**TABLE OF CONTENTS (Cont.)**

<b><u>Section</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
3D.4	Qualification Criteria.....	3D-3
3D.4.1	Qualification Guides .....	3D-3
3D.4.1.1	IEEE Standards .....	3D-3
3D.4.1.2	NRC Regulatory Guides.....	3D-5
3D.4.2	Definitions .....	3D-7
3D.4.3	Mild Versus Harsh Environments.....	3D-7
3D.4.4	Test Sequence .....	3D-8
3D.4.5	Aging .....	3D-9
3D.4.5.1	Design Life.....	3D-9
3D.4.5.2	Shelf Life.....	3D-9
3D.4.5.3	Qualified Life .....	3D-10
3D.4.5.4	Qualified Life Reevaluation .....	3D-11
3D.4.6	Operability Time.....	3D-12
3D.4.7	Performance Criterion.....	3D-12
3D.4.8	Margin .....	3D-12
3D.4.8.1	Normal and Abnormal Extremes.....	3D-13
3D.4.8.2	Aging.....	3D-13
3D.4.8.3	Radiation .....	3D-14
3D.4.8.4	Seismic Conditions.....	3D-14
3D.4.8.5	High-Energy Line Break Conditions .....	3D-15
3D.4.9	Treatment of Failures.....	3D-15
3D.4.10	Traceability .....	3D-15
3D.4.10.1	Auditable Link Document.....	3D-16
3D.4.10.2	Similarity.....	3D-16
3D.5	Design Specifications.....	3D-16
3D.5.1	Normal Operating Conditions .....	3D-17
3D.5.1.1	Pressure, Temperature, Humidity .....	3D-17
3D.5.1.2	Radiation Dose .....	3D-17
3D.5.2	Abnormal Operating Conditions .....	3D-18
3D.5.2.1	Abnormal Environments Inside Containment .....	3D-18
3D.5.2.2	Abnormal Environments Outside Containment.....	3D-19
3D.5.3	Seismic Events.....	3D-19
3D.5.4	Containment Test Environment .....	3D-19
3D.5.5	Design Basis Event Conditions .....	3D-19
3D.5.5.1	High-Energy Line Break Accidents Inside Containment.....	3D-19
3D.5.5.2	High-Energy Line Break Accidents Outside Containment .....	3D-23
3D.6	Qualification Methods.....	3D-23
3D.6.1	Type Test .....	3D-23
3D.6.2	Analysis .....	3D-24
3D.6.2.1	Similarity.....	3D-24
3D.6.2.2	Substitution .....	3D-25
3D.6.2.3	Analysis of Safety-Related Mechanical Equipment .....	3D-25
3D.6.3	Operating Experience .....	3D-28

**TABLE OF CONTENTS (Cont.)**

<b><u>Section</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
	3D.6.4 On-Going Qualification .....	3D-28
	3D.6.5 Combinations of Methods.....	3D-28
	3D.6.5.1 Use of Existing Qualification Reports.....	3D-28
3D.7	Documentation.....	3D-29
	3D.7.1 Equipment Qualification Data Package .....	3D-30
	3D.7.2 Specifications.....	3D-30
	3D.7.2.1 Equipment Identification .....	3D-30
	3D.7.2.2 Installation Requirements.....	3D-31
	3D.7.2.3 Electrical Requirements.....	3D-31
	3D.7.2.4 Auxiliary Devices.....	3D-31
	3D.7.2.5 Preventive Maintenance .....	3D-31
	3D.7.2.6 Performance Requirements .....	3D-31
	3D.7.2.7 Environmental Conditions.....	3D-32
	3D.7.3 Qualification Program.....	3D-32
	3D.7.4 Qualification by Test.....	3D-32
	3D.7.4.1 Specimen Description.....	3D-32
	3D.7.4.2 Number Tested .....	3D-33
	3D.7.4.3 Mounting.....	3D-33
	3D.7.4.4 Connections.....	3D-33
	3D.7.4.5 Test Sequence.....	3D-33
	3D.7.4.6 Simulated Service Conditions .....	3D-33
	3D.7.4.7 Measured Variables.....	3D-34
	3D.7.4.8 Type Test Summary .....	3D-34
	3D.7.5 Qualification by Analysis.....	3D-35
	3D.7.6 Qualification by Experience.....	3D-35
	3D.7.7 Qualification Program Conclusions .....	3D-35
	3D.7.8 Combined License Information.....	3D-35
3D.8	References .....	3D-35
	Appendix 3D-Attachment A – Sample Equipment Qualification Data Package (EQDP).....	3D-61
	Appendix 3D-Attachment B – Aging Evaluation Program .....	3D-79
B.1	Introduction.....	3D-79
B.2	Objectives .....	3D-79
B.3	Basic Approach .....	3D-79
B.4	Subprogram A .....	3D-80
	B.4.1 Scope .....	3D-80
	B.4.2 Aging Mechanisms .....	3D-80
	B.4.3 Time.....	3D-80
	B.4.4 Operational Stresses.....	3D-80
	B.4.5 External Stresses .....	3D-81
	B.4.6 Synergism .....	3D-82
	B.4.7 Design Basis Event Testing .....	3D-82

**TABLE OF CONTENTS (Cont.)**

<u>Section</u>	<u>Title</u>	<u>Page</u>
	B.4.8 Aging Sequence.....	3D-82
	B.4.9 Performance Criterion.....	3D-83
	B.4.10 Failure Treatment.....	3D-83
B.5	Subprogram B .....	3D-83
	B.5.1 Scope .....	3D-84
	B.5.2 Performance Criteria.....	3D-84
	B.5.3 Failure Treatment.....	3D-84
Appendix 3D-Attachment C – Effects of Gamma Radiation Doses Below $10^4$ Rads on the Mechanical Properties of Materials .....		3D-87
C.1	Introduction .....	3D-87
C.2	Scope.....	3D-88
C.3	Discussion .....	3D-88
C.4	Conclusions.....	3D-89
C.5	References.....	3D-89
Appendix 3D-Attachment D – Accelerated Thermal Aging Parameters .....		3D-94
D.1	Introduction.....	3D-94
D.2	Arrhenius Model .....	3D-94
D.3	Activation Energy .....	3D-96
D.4	Thermal Aging (Normal/Abnormal Operating Conditions) .....	3D-96
D.4.1	Normal Operation Temperature ( $T_0$ ) .....	3D-96
D.4.1.1	External Ambient Temperature ( $T_a$ ) .....	3D-96
D.4.1.2	Temperature Rise in Enclosure ( $T_r$ ).....	3D-97
D.4.1.3	Self-Heating Effects ( $T_j$ ).....	3D-97
D.4.2	Accelerated Aging Temperature ( $T_i$ ).....	3D-97
D.4.3	Examples of Arrhenius Calculations.....	3D-97
D.4.3.1	For a Normally Energized Component Aged Energized .....	3D-97
D.4.3.2	For a Normally De-energized Component Aged Energized .....	3D-98
D.5	Post-Accident Thermal Aging.....	3D-98
D.5.1	Post-Accident Operating Temperatures .....	3D-98
D.5.2	Accelerated Thermal Aging Parameters for Post-Accident Conditions.....	3D-98
D.6	References.....	3D-99
Appendix 3D-Attachment E – Seismic Qualification Techniques .....		3D-105
E.1	Purpose.....	3D-105
E.2	Definitions.....	3D-105
E.2.1	1/2 Safe Shutdown Earthquake.....	3D-105
E.2.2	Seismic Category I Equipment.....	3D-105
E.2.3	Seismic Category II Equipment .....	3D-105
E.2.4	Non-seismic Equipment.....	3D-105

**TABLE OF CONTENTS (Cont.)**

<b><u>Section</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
E.3	E.2.5 Active Equipment .....	3D-105
	E.2.6 Passive Equipment.....	3D-105
	E.3 Qualification Methods.....	3D-106
	E.3.1 Use of Qualification by Testing .....	3D-106
	E.3.2 Use of Qualification by Analysis .....	3D-106
E.4	E.4 Requirements .....	3D-107
	E.4.1 Damping .....	3D-107
	E.4.1.1 Testing.....	3D-107
	E.4.1.2 Analysis.....	3D-107
	E.4.2 Interface Requirements .....	3D-107
	E.4.3 Mounting Simulation .....	3D-107
	E.4.4 1/2 Safe Shutdown Earthquake.....	3D-108
	E.4.5 Safe Shutdown Earthquake .....	3D-108
	E.4.6 Other Dynamic Loads .....	3D-108
E.5	E.5 Qualification by Test .....	3D-108
	E.5.1 Qualification of Hard-Mounted Equipment .....	3D-109
	E.5.2 Qualification of Line-Mounted Equipment.....	3D-110
	E.5.2.1 Seismic Qualification Test Sequence .....	3D-110
	E.5.2.2 Line Vibration Aging .....	3D-110
	E.5.2.3 Single Frequency Testing.....	3D-111
	E.5.2.4 Seismic Aging .....	3D-111
	E.5.2.5 Static Deflection Testing of Active Valves .....	3D-111
	E.5.3 Operational Conditions .....	3D-112
	E.5.4 Resonant Search Testing.....	3D-112
E.6	E.6 Qualification by Analysis .....	3D-112
	E.6.1 Modeling.....	3D-113
	E.6.2 Qualification by Static Analysis.....	3D-113
	E.6.3 Qualification by Dynamic Analysis .....	3D-113
	E.6.3.1 Response Spectrum Analysis.....	3D-114
	E.6.3.2 Static Coefficient Method.....	3D-114
	E.6.3.3 Time History Analysis.....	3D-114
E.7	E.7 Qualification by Test Experience .....	3D-114
E.8	E.8 Performance Criteria .....	3D-115
	E.8.1 Equipment Qualification by Test .....	3D-115
	E.8.2 Equipment Qualification by Analysis .....	3D-115
	E.8.2.1 Structural Integrity.....	3D-115
	E.8.2.2 Operability.....	3D-115
	<b>APPENDIX 3E HIGH-ENERGY PIPING IN THE NUCLEAR ISLAND .....</b>	<b>3E-1</b>

**TABLE OF CONTENTS (Cont.)**

<u>Section</u>	<u>Title</u>	<u>Page</u>
<b>APPENDIX 3F CABLE TRAYS AND CABLE TRAY SUPPORTS .....</b> 3F-1		
3F.1	Codes and Standards .....	3F-1
3F.2	Loads and Load Combinations.....	3F-1
	3F.2.1 Loads .....	3F-1
	3F.2.1.1 Dead Load (D).....	3F-1
	3F.2.1.2 Construction Live Load (L).....	3F-1
	3F.2.1.3 Safe Shutdown Earthquake ( $E_s$ ) .....	3F-2
	3F.2.1.4 Thermal Load .....	3F-2
	3F.2.2 Load Combinations.....	3F-2
3F.3	Analysis and Design.....	3F-2
	3F.3.1 Damping .....	3F-2
	3F.3.2 Seismic Analysis.....	3F-3
	3F.3.3 Allowable Stresses .....	3F-3
	3F.3.4 Connections .....	3F-3
<b>APPENDIX 3G NUCLEAR ISLAND SEISMIC ANALYSES .....</b> 3G-1		
3G.1	Introduction.....	3G-1
3G.2	Nuclear Island Finite Element Models .....	3G-1
	3G.2.1 Individual Building and Equipment Models .....	3G-2
	3G.2.1.1 Coupled Auxiliary and Shield Building .....	3G-2
	3G.2.1.2 Containment Internal Structures .....	3G-3
	3G.2.1.3 Containment Vessel.....	3G-3
	3G.2.1.4 Polar Crane.....	3G-4
	3G.2.1.5 Major Equipment and Structures Using Stick Models .....	3G-5
	3G.2.2 Nuclear Island Dynamic Models.....	3G-5
	3G.2.2.1 NI10 Model .....	3G-5
	3G.2.2.2 NI20 Model .....	3G-5
	3G.2.2.3 Nuclear Island Stick Model .....	3G-6
	3G.2.2.4 NI05 Model .....	3G-6
	3G.2.2.5 Seismic Stability Model .....	3G-6
	3G.2.3 Static Models .....	3G-7
	3G.2.3.1 Quadrant Model of Shield Building Roof .....	3G-7
	3G.2.3.2 Containment Vessel 3D Finite Element Model .....	3G-7
	3G.2.3.3 Containment Vessel Axisymmetric Model .....	3G-7
3G.3	2D SASSI Analyses .....	3G-8
3G.4	Nuclear Island Dynamic Analyses.....	3G-9
	3G.4.1 ANSYS Fixed Base Analysis.....	3G-9
	3G.4.2 3D SASSI Analyses .....	3G-9
	3G.4.3 Seismic Analysis.....	3G-10
	3G.4.3.1 Response Spectrum Analysis.....	3G-10
	3G.4.3.2 Absolute Accelerations.....	3G-11
	3G.4.3.3 Seismic Response Spectrum.....	3G-11
	3G.4.3.4 Bearing Pressure Demand .....	3G-11

**TABLE OF CONTENTS (Cont.)**

<b>Section</b>	<b>Title</b>	<b>Page</b>
3G.5	References .....	3G-12
<b>APPENDIX 3H AUXILIARY AND SHIELD BUILDING CRITICAL SECTIONS .....3H-1</b>		
3H.1	Introduction .....	3H-1
3H.2	Description of Auxiliary and Shield Buildings .....	3H-1
3H.2.1	Description of Auxiliary Building.....	3H-1
3H.2.2	Description of Shield Building .....	3H-2
3H.3	Design Criteria .....	3H-4
3H.3.1	Governing Codes and Standards .....	3H-5
3H.3.2	Seismic Input .....	3H-5
3H.3.3	Loads.....	3H-5
3H.3.4	Load Combinations and Acceptance Criteria.....	3H-9
3H.4	Seismic Analyses.....	3H-10
3H.4.1	Live Load for Seismic Design.....	3H-10
3H.5	Structural Design of Critical Sections .....	3H-10
3H.5.1	Shear Walls.....	3H-11
3H.5.1.1	Exterior Wall at Column Line 1 .....	3H-13
3H.5.1.2	Wall at Column Line 7.3 .....	3H-13
3H.5.1.3	Wall at Column Line L.....	3H-13
3H.5.1.4	Wall at Column Line 11 .....	3H-14
3H.5.2	Composite Structures (Floors and Roof).....	3H-14
3H.5.2.1	Roof at Elevation 180'-0", Area 6 (Critical Section is between Col. Lines N & K-2 and 3 & 4).....	3H-16
3H.5.2.2	Floor at Elevation 135'-3", Area 1 (Between Column Lines M and P).....	3H-16
3H.5.3	Reinforced Concrete Slabs.....	3H-17
3H.5.3.1	Operations Work Area (Tagging Room) Ceiling.....	3H-17
3H.5.4	Concrete Finned Floors.....	3H-17
3H.5.5	Structural Modules.....	3H-18
3H.5.5.1	West Wall of Spent Fuel Pool .....	3H-19
3H.5.6	Shield Building Roof and Connections.....	3H-20
3H.5.6.1	Air Inlets and Tension Ring .....	3H-21
3H.5.6.2	Compression Ring, and Interior Wall of Passive Containment Cooling Water Storage Tank .....	3H-21
3H.5.6.3	Knuckle Region and Exterior Wall of Passive Containment Cooling System Tank .....	3H-21
3H.5.7	Shield Building Cylinder (SC).....	3H-22
3H.5.7.1	Shield Building Cylindrical Wall .....	3H-22
3H.5.7.2	Reinforced Concrete (RC)/Steel Concrete Composite (SC) Horizontal and Vertical Connections .....	3H-23
3H.5.8	References.....	3H-23
<b>APPENDIX 3I EVALUATION FOR HIGH FREQUENCY SEISMIC INPUT .....3I-1</b>		
3I.1	Introduction .....	3I-1

**TABLE OF CONTENTS (Cont.)**

<b><u>Section</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
3I.2	High Frequency Seismic Input .....	3I-1
3I.3	NI Models Used To Develop High Frequency Response .....	3I-2
3I.4	Evaluation Methodology .....	3I-2
3I.5	General Selection Screening Criteria .....	3I-3
3I.6	Evaluation .....	3I-3
3I.6.1	Building Structures .....	3I-4
3I.6.2	Primary Coolant Loop.....	3I-4
3I.6.3	Piping Systems.....	3I-5
3I.6.4	Electrical and Electro-Mechanical Equipment.....	3I-5
3I.7	References.....	3I-10

**LIST OF TABLES**

<b>Table No.</b>	<b>Title</b>	<b>Page</b>
3.2-1	Comparison of Safety Classification Requirements .....	3.2-18
3.2-2	Seismic Classification of Building Structures .....	3.2-19
3.2-3	AP1000 Classification of Mechanical and Fluid Systems, Components, and Equipment (Sheets 1 – 75) .....	3.2-20
3.6-1	High-Energy and Moderate-Energy Fluid Systems Considered for Protection of Essential Systems.....	3-6.38
3.6-2	Subcompartments and Postulated Pipe Ruptures (Pages 1 – 7).....	3-6.39
3.6-3	NI Rooms with Pipe Whip Restraints and Corresponding Hazard Sources and Essential Targets (Sheets 1 – 7).....	3.6-46
3.7.1-1	Safe Shutdown Earthquake Damping Values.....	3.7-53
3.7.1-2	Embedment Depth and Related Dimensions of Category I Structures .....	3.7-54
3.7.1-3	AP1000 Design Response Spectra Amplification Factors for Control Points .....	3.7-55
3.7.1-4	Strain Compatible Soil Properties (Sheets 1 – 5) .....	3.7-56
3.7.2-1	(Tables 3.7.2-1 through 3.7.2-16 Not Used)	
3.7.3-1	Seismic Category I Equipment Outside Containment by Room Number (Sheets 1 – 3).....	3.7-62
3.7.3-2	Equipment Classified as Sensitive Targets for Seismically Analyzed Piping, HVAC Ducting, Cable Trays .....	3.7-65
3.8.2-1	Load Combinations and Service Limits for Containment Vessel .....	3.8-81
3.8.2-2	Containment Vessel Pressure Capabilities .....	3.8-82
3.8.2-3	Analysis and Test Results of Fabricated Heads.....	3.8-83
3.8.2-4	Summary of Containment Vessel Models and Analysis Methods .....	3.8-84
3.8.2-5	Maximum Absolute Nodal Acceleration (ZPA) Steel Containment Vessel .....	3.8-85
3.8.3-1	Shear and Flexural Stiffnesses of Structural Module Walls .....	3.8-86
3.8.3-2	Summary of Containment Internal Structures Models and Analysis Methods .....	3.8-87
3.8.3-3	Definition of Critical Locations and Thicknesses for Containment Internal Structures .....	3.8-88
3.8.3-4	Design Summary of West Wall of Refueling Canal Design Loads, Load Combinations, and Comparison to Acceptance Criteria Mid-Span at Mid-Height (Sheet 1 of 3) .....	3.8-89
3.8.3-4	Design Summary of West Wall of Refueling Canal Design Loads, Load Combinations, and Comparison to Acceptance Criteria Mid-Span at Base (Sheet 2 of 3).....	3.8-90
3.8.3-4	Design Summary of West Wall of Refueling Canal Design Loads, Load Combinations, and Comparison to Acceptance Criteria Mid-Span at Base (Sheet 3 of 3).....	3.8-91
3.8.3-5	Design Summary of South Wall of Steam Generator Compartment Design Loads, Load Combinations, and Comparison to Acceptance Criteria Mid-Span at Mid-Height (Sheet 1 of 3) .....	3.8-92
3.8.3-5	Design Summary of South Wall of Steam Generator Compartment Design Loads, Load Combinations, and Comparison to Acceptance Criteria Mid-Span at Mid-Height (Sheet 2 of 3) .....	3.8-93
3.8.3-5	Design Summary of South Wall of Steam Generator Compartment Design Loads, Load Combinations, and Comparison to Acceptance Criteria West End Bottom Corner (Sheet 3 of 3).....	3.8-94

**LIST OF TABLES (Cont.)**

<b>Table No.</b>	<b>Title</b>	<b>Page</b>
3.8.3-6	Design Summary of North-East Wall of IRWST Design Loads, Load Combinations, and Comparison to Acceptance Criteria Mid-Span at Mid-Height (Sheet 1 of 3) .....	3.8-95
3.8.3-6	Design Summary of North-East Wall of IRWST Design Loads, Load Combinations, and Comparison to Acceptance Criteria Mid-Span at Bottom – Elevation 107'-2" (Sheet 2 of 3) .....	3.8-96
3.8.3-6	Design Summary of North-East Wall of IRWST Design Loads, Load Combinations, and Comparison to Acceptance Criteria North End Bottom Corner – Elevation 107'-2" (Sheet 3 of 3) .....	3.8-97
3.8.3-7	Design Summary of Steel Wall of IRWST .....	3.8-98
3.8.4-1	Load Combinations and Load Factors for Seismic Category I Steel Structures .....	3.8-99
3.8.4-2	Load Combinations and Load Factors for Seismic Category I Concrete Structures .....	3.8-100
3.8.4-3	Acceptance Tests for Concrete Aggregates .....	3.8-101
3.8.4-4	Criteria for Water Used in Production of Concrete .....	3.8-102
3.8.4-5	Types of Water Reducing Agents Used in Production of Concrete.....	3.8-103
3.8.4-6	Materials Used in Structural and Miscellaneous Steel (Sheets 1 – 2).....	3.8-104
3.8.5-1	Minimum Required Factor of Safety for Overturning and Sliding of Structures.....	3.8-106
3.8.5-2	Factors of Safety for Flotation, Overturning and Sliding of Nuclear Island Structures .....	3.8-107
3.8.5-3	Definition of Critical Locations, Thicknesses and Reinforcement for Nuclear Island Basemat (in <sup>2</sup> /ft).....	3.8-108
3.9-1	Reactor Coolant System Design Transients (Sheets 1 – 2).....	3.9-102
3.9-2	Pump Starting/Stopping Conditions .....	3.9-104
3.9-3	Loadings for ASME Class 1, 2, 3, CS and Supports (Sheets 1 – 2) .....	3.9-105
3.9-4	First Plant AP1000 Reactor Internals Vibration Measurement Program Transducer Locations .....	3.9-107
3.9-5	Minimum Design Loading Combinations for ASME Class 1, 2, 3 and CS Systems and Components .....	3.9-108
3.9-6	Additional Load Combinations and Stress Limits for ASME Class 1 Piping .....	3.9-109
3.9-7	Additional Load Combinations and Stress Limits for ASME Class 2, 3 Piping .....	3.9-110
3.9-8	Minimum Design Loading Combinations for Supports for ASME Class 1, 2, 3 Piping and Components .....	3.9-111
3.9-9	Stress Criteria for ASME Code Section III Class 1 Components and Supports and Class CS Core Supports .....	3.9-112
3.9-10	Stress Criteria for ASME Code Section III Class 2 and 3 Components and Supports .....	3.9-114
3.9-11	Piping Functional Capability – ASME Class 1, 2, and 3.....	3.9-116
3.9.12	List of ASME Class 1, 2, and 3 Active Valves (Sheets 1 – 7) .....	3.9-117
3.9-13	Control Rod Drive Mechanism Production Tests.....	3.9-124
3.9-14	Maximum Deflections Allowed for Reactor Internal Support Structures.....	3.9-125
3.9-15	Computer Programs for Seismic Category 1 Components .....	3.9-126
3.9.16	Valve Inservice Test Requirements (Sheets 1 – 26) .....	3.9-127

**LIST OF TABLES (Cont.)**

<b>Table No.</b>	<b>Title</b>	<b>Page</b>
3.9-17	System Level Operability Test Requirements .....	3.9-185
3.9-18	AP1000 Pressure Isolation Valves .....	3.9-187
3.9-19	Critical Piping Design Methods and Criteria (Piping Design Criteria) (Sheets 1 – 2) .....	3.9-188
3.9-20	Piping Packages Chosen to Demonstrate Piping Design for Piping DAC Closure (Sheets 1 – 2) .....	3.9-190
3.11-1	Environmentally Qualified Electrical and Mechanical Equipment (Sheets 1 – 51) .....	3.11-6
3B-1	AP1000 Leak-before-Break Bounding Analysis Systems and Parameters (Sheets 1 – 2) .....	3B-19
3D.4-1	Typical Mild Environment Parameter Limits .....	3D-37
3D.4-2	Equipment Post-Accident Operability Times .....	3D-38
3D.4-3	AP1000 EQ Program Margin Requirements .....	3D-39
3D.5-1	Normal Operating Environments (Sheets 1 – 3).....	3D-40
3D.5-2	60-Year Normal Operating Doses .....	3D-43
3D.5-3	Abnormal Operating Environments Inside Containment .....	3D-44
3D.5-4	Abnormal Operating Environments Outside Containment (Sheets 1 – 2).....	3D-45
3D.5-5	Accident Environments .....	3D-47
3D.6-1	Mechanical Equipment Components Requiring Environmental Qualification.....	3D-48
3D.B-1	Typical Class 1E Equipment Scope and Subprogram Allocation.....	3D-85
3D.B-2	Aging Mechanism Sequence .....	3D-86
3D.C-1	Radiation-Induced Degradation of Material Mechanical Properties (Sheets 1 – 2)....	3D-91
3D.D-1	Activation Energies From Westinghouse Reports (Sheets 1 – 2) .....	3D-100
3G.1-1	Summary of Models and Analysis Methods (Sheets 1 – 3).....	3G-13
3G.1-2	Summary of Dynamic Analyses and Combination Techniques.....	3G-17
3G.2-1	Steel Containment Vessel Lumped-Mass Stick Model (Without Polar Crane) Modal Properties (Sheet 1).....	3G-18
3G.2-1	Steel Containment Vessel Lumped-Mass Stick Model (With Polar Crane) Modal Properties (Sheet 2).....	3G-19
3G.2-2	Comparison of Frequencies for Containment Vessel Seismic Model.....	3G-20
3G.3-1	AP1000 ZPA for 2D SASSI Cases .....	3G-21
3G.4-1	Key Nodes at Location .....	3G-22
3G.4-2	Maximum Bearing Pressure from 2D Time History Analysis .....	3G-23
3H.5-1	Nuclear Island: Design Temperatures for Thermal Gradient.....	3H-24
3H.5-2	Exterior Wall at Column Line 1 Forces and Moments in Critical Locations.....	3H-25
3H.5-3	Exterior Wall on Column Line 1 Details of Wall Reinforcement (inch <sup>2</sup> /ft) .....	3H-26
3H.5-4	Interior Wall at Column Line 7.3 Forces and Moments In Critical Locations.....	3H-27
3H.5-5	Interior Wall on Column Line 7.3 Details of Wall Reinforcement .....	3H-28
3H.5-6	Interior Wall at Column Line L Forces and Moments In Critical Locations .....	3H-29
3H.5-7	Interior Wall on Column Line L Details of Wall Reinforcement .....	3H-30
3H.5-8	Design Summary of Spent Fuel Pool Wall Design Loads, Load Combinations, and Comparisons to Acceptance Criteria – Element No. 20477 (Sheet 1).....	3H-31

**LIST OF TABLES (Cont.)**

<b><u>Table No.</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
3H.5-8	Design Summary of Spent Fuel Pool Wall Design Loads, Load Combinations, and Comparisons to Acceptance Criteria – Element No. 10529 (Sheet 2) .....	3H-32
3H.5-8	Design Summary of Spent Fuel Pool Wall Design Loads, Load Combinations, and Comparisons to Acceptance Criteria – Element No. 10544 (Sheet 3) .....	3H-33
3H.5-8	Design Summary of Spent Fuel Pool Wall Design Loads, Load Combinations, and Comparisons to Acceptance Criteria – Element No. 10524 (Sheet 4) .....	3H-34
3H.5-8	Design Summary of Spent Fuel Pool Wall Design Loads, Load Combinations, and Comparisons to Acceptance Criteria – Element No. 20462 (Sheet 5) .....	3H-35
3H.5-8	Design Summary of Spent Fuel Pool Wall Design Loads, Load Combinations, and Comparisons to Acceptance Criteria – Element No. 21402 (Sheet 6) .....	3H-36
3H.5-8	Design Summary of Spent Fuel Pool Wall Design Loads, Load Combinations, and Comparisons to Acceptance Criteria – Element No. 21414 (Sheet 7) .....	3H-37
3H.5-9	Shield Building Roof Reinforcement Summary (Sheets 1–3).....	3H-38
3H.5-10	Design Summary of Roof at Elevation 180'-0", Area 6.....	3H-43
3H.5-11	Design Summary of Floor at Elevation 135'-3" Area 1 (Between Column Lines M And P).....	3H-44
3H.5-12	Design Summary of Floor at Elevation 135'-3" (Operations Work Area (Previously Known As ‘Tagging Room’ Ceiling)).....	3H-45
3H.5-13	Design Summary of Floor at Elevation 135'-3" Area 1 (Main Control Room Ceiling).....	3H-46
3H.5-14	Design Summary of Enhanced Shield Building Cylindrical Wall Load Combinations, and Comparison to Acceptance Criteria Elevation 180 Feet Near Fuel Handling Building Roof (Sheet 1).....	3H-47
3H.5-14	Design Summary of Enhanced Shield Building Load Combinations, and Comparison to Acceptance Criteria Elevation 175 Feet Near Intersection With Wall 7.3 (Sheet 2) .....	3H-48
3H.5-14	Design Summary of Enhanced Shield Building Load Combinations, and Comparison to Acceptance Criteria Elevation Grade on West Side (Sheet 3).....	3H-49
3H.5-15	Shield Building Roof Reinforcement Ratio of Code Required Versus Provided .....	3H-50
3I.6-1	Potential High Frequency Sensitive Equipment List .....	3I-11
3I.6-2	List of Potential High Frequency Sensitive AP1000 Safety-Related Electrical and Electro-Mechanical Equipment (Sheets 1 – 28) .....	3I-12
3I.6-3	List of AP1000 Safety-Related Electrical and Mechanical Equipment Not High Frequency Sensitive (Sheets 1 – 32) .....	3I-40

**LIST OF FIGURES**

<b><u>Figure No.</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
3.3-1	Velocity Pressure Variation with Radius from Center of Tornado .....	3.3-6
3.4-1	Typical Details of Nuclear Island Waterproofing Below Grade.....	3.4-25
3.4-2	Typical Details of Nuclear Island Waterproofing Below Grade with Step.....	3.4-26
3.4-3	Not Used	
3.4-4	Typical Details of Membrane Corner Detail at Basemat and Exterior Wall.....	3.4-28
3.6-1	Typical U-Bar Restraint .....	3.6-53
3.6-2	Typical Energy Absorbing Material Restraint.....	3.6-54
3.6-3	Terminal Ends Definitions .....	3.6-55
3.7.1-1	Horizontal Design Response Spectra Safe Shutdown Earthquake .....	3.7-66
3.7.1-2	Vertical Design Response Spectra Safe Shutdown Earthquake .....	3.7-67
3.7.1-3	Design Horizontal Time History, "H1" Acceleration, Velocity & Displacement Plots.....	3.7-68
3.7.1-4	Design Horizontal Time History, "H2" Acceleration, Velocity & Displacement Plots.....	3.7-69
3.7.1-5	Design Vertical Time History Acceleration, Velocity & Displacement Plots .....	3.7-70
3.7.1-6	Acceleration Response Spectra of Design Horizontal Time History, "H1" .....	3.7-71
3.7.1-7	Acceleration Response Spectra of Design Horizontal Time History, "H2" .....	3.7-72
3.7.1-8	Acceleration Response Spectra of Design Vertical Time History .....	3.7-73
3.7.1-9	Minimum Power Spectral Density Curve (Normalized to 0.3g).....	3.7-74
3.7.1-10	Power Spectral Density of Design Horizontal Time History, "H1" .....	3.7-75
3.7.1-11	Power Spectral Density of Design Horizontal Time History, "H2" .....	3.7-76
3.7.1-12	Power Spectral Density of Design Vertical Time History .....	3.7-77
3.7.1-13	Not Used	
3.7.1-14	Nuclear Island Structures Dimensions .....	3.7-79
3.7.1-15	Strain Dependent Properties of Rock Material (Ref. 37).....	3.7-80
3.7.1-16	Strain Dependent Properties of Soil Material (Ref. 38).....	3.7-81
3.7.1-17	Generic Soil Profiles .....	3.7-82
3.7.2-1	(Figures 3.7.2-1 through 3.7.2-11 Not Used)	
3.7.2-12	Nuclear Island Key Structural Dimensions Plan at El. 66'-6" (Sheet 1).....	3.7-85
3.7.2-12	Nuclear Island Key Structural Dimensions Plan at El. 82'-6" (Sheet 2).....	3.7-87
3.7.2-12	Nuclear Island Key Structural Dimensions Plan at El. 100'-0" & 107'-2" (Sheet 3).....	3.7-89
3.7.2-12	Nuclear Island Key Structural Dimensions Plan at El. 117'-6" (Sheet 4).....	3.7-91
3.7.2-12	Nuclear Island Key Structural Dimensions Plan at El. 135'-3" (Sheet 5).....	3.7-93
3.7.2-12	Nuclear Island Key Structural Dimensions Plan at El. 153'-0" & 160'-6" (Sheet 6).....	3.7-95
3.7.2-12	Nuclear Island Key Structural Dimensions Plan at El. 160'-6", 180'-0", & 329'-0" (Sheet 7) .....	3.7-97
3.7.2-12	Nuclear Island Key Structural Dimensions Section A - A (Sheet 8) .....	3.7-99
3.7.2-12	Nuclear Island Key Structural Dimensions Section B - B (Sheet 9).....	3.7-101
3.7.2-12	Nuclear Island Key Structural Dimensions Sections C - C and H - H (Sheet 10).....	3.7-103
3.7.2-12	Nuclear Island Key Structural Dimensions Section G - G (Sheet 11) .....	3.7-105

**LIST OF FIGURES (Cont.)**

<b><u>Figure No.</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
3.7.2-12	Nuclear Island Key Structural Dimensions Section J - J (Sheet 12).....	3.7-107
3.7.2-13	Not Used	
3.7.2-14	Typical Design Floor Response Spectrum.....	3.7-110
3.7.2-15	(Figures 3.7.2-15 through 3.7.2-18 Not Used)	
3.7.2-19	Annex Building Key Structural Dimensions Plan at Elevation 100'-0" (Sheet 1).....	3.7-113
3.7.2-19	Annex Building Key Structural Dimensions Plan at Elevation 107'-2" and 117'-6" (Sheet 2).....	3.7-115
3.7.2-19	Annex Building Key Structural Dimensions Plan at Elevation 135'-3" (Sheet 3).....	3.7-117
3.7.2-19	Annex Building Key Structural Dimensions Plan at Elevation 158'-0" and 146'-3" (Sheet 4).....	3.7-119
3.7.2-19	Annex Building Key Structural Dimensions Roof Plan at Elevation 154'-0" and 181'-11 3/4" (Sheet 5) .....	3.7-121
3.7.2-19	Annex Building Key Structural Dimensions Section A - A (Sheet 6).....	3.7-123
3.7.2-19	Annex Building Key Structural Dimensions Section B - B (Sheet 7) .....	3.7-125
3.7.2-19	Annex Building Key Structural Dimensions Section C - C (Sheet 8) .....	3.7-127
3.7.2-19	Annex Building Key Structural Dimensions Sections D - D, E - E, & F - F (Sheet 9) .....	3.7-129
3.7.2-19	Annex Building Key Structural Dimensions Sections G - G, H - H, & J - J (Sheet 10) .....	3.7-131
3.7.2-20	East-West 2D SASSI Model with Adjacent Buildings.....	3.7-133
3.7.2-21	2D North-South SASSI Model with Adjacent Buildings .....	3.7-134
3.7.2-22	3D SASSI Model with Adjacent Buildings.....	3.7-135
3.7.3-1	Impact Evaluation Zone .....	3.7-136
3.7.3-2	Impact Evaluation Zone and Seismic Supported Piping.....	3.7-137
3.8.2-1	Containment Vessel General Outline (Sheets 1 – 3) .....	3.8-109
3.8.2-2	Equipment Hatches .....	3.8-113
3.8.2-3	Personnel Airlock .....	3.8-115
3.8.2-4	Containment Penetrations Main Steam (Sheet 1).....	3.8-117
3.8.2-4	Containment Penetrations Startup Feedwater (Sheet 2) .....	3.8-118
3.8.2-4	Containment Penetrations Normal RHR Piping (Sheet 3).....	3.8-119
3.8.2-4	Containment Penetrations (Sheet 4) .....	3.8-120
3.8.2-4	Containment Penetrations Fuel Transfer Penetration (Sheet 5).....	3.8-121
3.8.2-4	Containment Penetrations Typical Electrical Penetration (Sheet 6) .....	3.8-123
3.8.2-4	Containment Penetrations Steam Line and Feedwater Line Insert Plates (Sheet 7) ..	3.8-125
3.8.2-5	Containment Vessel Response to Internal Pressure of 59 psig Displaced Shape Plot (Sheet 1) .....	3.8-126
3.8.2-5	Containment Vessel Response to Internal Pressure of 59 psig Membrane Stresses (ksi) (Sheet 2) .....	3.8-127
3.8.2-5	Containment Vessel Response to Internal Pressure of 59 psig Surface Meridional Stress (ksi) (Sheet 3).....	3.8-128

**LIST OF FIGURES (Cont.)**

<b>Figure No.</b>	<b>Title</b>	<b>Page</b>
3.8.2-5	Containment Vessel Response to Internal Pressure of 59 psig Outside Surface Stresses (ksi) (Sheet 4).....	3.8-129
3.8.2-5	Containment Vessel Response to Internal Pressure of 59 psig Outer Stress Intensity (ksi) (Sheet 5).....	3.8-130
3.8.2-6	Containment Vessel Axisymmetric Model (Sheets 1 – 2).....	3.8-131
3.8.2-7	Finite Element Model for Local Buckling Analyses .....	3.8-133
3.8.2-8	Location of Containment Seal (Sheet 1).....	3.8-134
3.8.2-8	Seal Sections and Details (Sheet 2).....	3.8-135
3.8.3-1	Structural Modules in Containment Internal Structures (Sheets 1 – 7) .....	3.8-136
3.8.3-2	Typical Structural Wall Module .....	3.8-143
3.8.3-3	Typical Structural Floor Module .....	3.8-144
3.8.3-4	Reactor Vessel Supports.....	3.8-145
3.8.3-5	Steam Generator Supports (Sheets 1 – 5).....	3.8-147
3.8.3-6	Pressurizer Support Columns (Sheet 1).....	3.8-154
3.8.3-6	Pressurizer Lower Lateral Supports (Sheet 2) .....	3.8-155
3.8.3-6	Pressurizer Lower Supports (Sheet 3) .....	3.8-156
3.8.3-6	Pressurizer Upper Supports (Sheet 4) .....	3.8-157
3.8.3-7	IRWST Temperature Transient.....	3.8-158
3.8.3-8	Structural Modules – Typical Design Details (Sheets 1 – 3).....	3.8-159
3.8.3-9	Test Tank Finite Element Model.....	3.8-165
3.8.3-10	IRWST Fluid Structure Finite Element Model CIS Structural Model (Sheet 1).....	3.8-166
3.8.3-10	IRWST Fluid Structure Finite Element Model IRWST Structural Model (Sheet 2).....	3.8-167
3.8.3-11	IRWST Fluid Structure Finite Element Model Fluid Model.....	3.8-168
3.8.3-12	IRWST Fluid Structure Finite Element Model Sparger Region Detail .....	3.8-169
3.8.3-13	Effective Sections for Floor Modules.....	3.8-170
3.8.3-14	CA-01 Module (Sheet 1).....	3.8-171
3.8.3-14	CA-02 Module (Sheet 2).....	3.8-172
3.8.3-14	CA-03 Module (Sheet 3).....	3.8-173
3.8.3-14	CA-04 Structural Module (Sheet 4) .....	3.8-174
3.8.3-14	CA-05 Module (Sheet 5).....	3.8-175
3.8.3-15	Typical Submodule (Sheets 1 – 2) .....	3.8-176
3.8.3-16	Typical Liner Modules .....	3.8-179
3.8.3-17	Structural Modules – Design Details Standard Floor Connection (Sheet 1) .....	3.8-181
3.8.3-17	Structural Modules – Design Details Heavily Loaded Floor Connection (Sheet 2) .....	3.8-183
3.8.3-18	Location of Structural Wall Modules .....	3.8-185
3.8.4-1	Containment Air Baffle General Arrangement (Sheet 1) .....	3.8-186
3.8.4-1	Containment Air Baffle Panel Types (Sheet 2) .....	3.8-187
3.8.4-1	Containment Air Baffle Typical Panel on Cylinder (Sheet 3).....	3.8-188
3.8.4-1	Containment Air Baffle Sliding Plate (Sheet 4) .....	3.8-189
3.8.4-2	Passive Containment Cooling Tank .....	3.8-190
3.8.4-3	Not Used	

**LIST OF FIGURES (Cont.)**

<b>Figure No.</b>	<b>Title</b>	<b>Page</b>
3.8.4-4	Structural Modules in Auxiliary Building (Sheets 1 – 5) .....	3.8-192
3.8.4-5	Shield Building Structure Key Areas .....	3.8-197
3.8.5-1	Foundation Plan .....	3.8-199
3.8.5-2	Isometric View of Finite Element Model .....	3.8-201
3.8.5-3	Radial Reinforcement, Top Side of DISH (Sheet 1) .....	3.8-202
3.8.5-3	Circumferential Reinforcement, Top Side of DISH (Sheet 2).....	3.8-203
3.8.5-3	Longitudinal Reinforcement Map, Top Side in NS Direction (Sheet 3) .....	3.8-204
3.8.5-3	Longitudinal Reinforcement Map, Top Side in EW Direction (Sheet 4) .....	3.8-205
3.8.5-3	Longitudinal Reinforcement, Bottom Side of DISH and 6' Basemat (NS) (Sheet 5) .....	3.8-206
3.8.5-3	Longitudinal Reinforcement, Bottom Side of DISH and 6' Basemat (EW) (Sheet 6) .....	3.8-207
3.8.5-3	Shear Reinforcement Map (Sheet 7) .....	3.8-208
3.9-1	(Figures 3.9-1 through 3.9-3 Not Used)	
3.9-4	Control Rod Drive Mechanism .....	3.9-193
3.9-5	Lower Reactor Internals .....	3.9-194
3.9-6	Upper Core Support Structure.....	3.9-195
3.9-7	Integrated Head Package .....	3.9-196
3.9-8	Reactor Internals Interface Arrangement.....	3.9-197
3.9-9	Flow Skirt Schematic .....	3.9-198
3B-1	Typical Bounding Analysis Curve (BAC).....	3B-21
3B-2	Bounding Analysis Curve for Primary Loop Hot Leg.....	3B-22
3B-3	Bounding Analysis Curve for Primary Loop Cold Leg .....	3B-23
3B-4	Bounding Analysis Curve for 38" Main Steam Line.....	3B-24
3B-5	Bounding Analysis Curve for 20" Normal RHR .....	3B-25
3B-6	Bounding Analysis Curve for 18" Surge Line (Sheets 1 – 2).....	3B-26
3B-7	Bounding Analysis Curve for 18" PRHR Supply/ADS 4.....	3B-28
3B-8	Bounding Analysis Curve for 14" PRHR Supply to Cold Trap, PRHR Supply/ADS4.....	3B-29
3B-9	Bounding Analysis Curve for 14" PRHR Supply after Cold Trap, Return – to Isolation Valve .....	3B-30
3B-10	Bounding Analysis Curve for 14" ADS Stage 2, 3 .....	3B-31
3B-11	Bounding Analysis Curve for 14" PRHR Return – after Isolation Valve, 14" PRHR Return.....	3B-32
3B-12	Not Used	
3B-13	Bounding Analysis Curve for 8" Accumulator to Isolation Valve.....	3B-34
3B-14	Bounding Analysis Curve for 8" CMT Cold Leg Balance Line and Vent, DVI Cold Trap to RV.....	3B-35
3B-15	Bounding Analysis Curve for 8" CMT, DVI IWRST (Various Sections).....	3B-36
3B-16	Not Used	
3B-17	Bounding Analysis Curve for Accumulator after Isolation Valve.....	3B-38
3B-18	Bounding Analysis Curve for RNS Discharge .....	3B-39
3B-19	Bounding Analysis Curve for ADS Header to RCS Safety Valve.....	3B-40

**LIST OF FIGURES (Cont.)**

<b><u>Figure No.</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
3B-20	Bounding Analysis Curve for 12" Normal RHR .....	3B-41
3B-21	Bounding Analysis Curve for 10" Normal RHR .....	3B-42
3B-22	Bounding Analysis Curve for 8" ADS Stage 2, 3 .....	3B-43
3D.5-1	Typical Abnormal Environmental Test Profile: Main Control Room (Sheet 1 of 3)..	3D-49
3D.5-1	Typical Abnormal Environmental Test Profile: I&C and DC Equipment Rooms (Sheet 2 of 3).....	3D-50
3D.5-1	Typical Abnormal Environmental Test Profile: Voltage and Frequency Variations (Sheet 3 of 3).....	3D-51
3D.5-2	Gamma Dose and Dose Rate Inside Containment After a LOCA .....	3D-52
3D.5-3	Beta Dose and Dose Rate Inside Containment After a LOCA .....	3D-53
3D.5-4	Gamma Dose and Dose Rate Inside Containment After a Steam Line Break .....	3D-54
3D.5-5	Beta Dose and Dose Rate Inside Containment After a Steam Line Break.....	3D-55
3D.5-6	(Figures 3D.5-6 and 3D.5-7 Not Used)	
3D.5-8	Typical Combined LOCA/SLB/FLB Inside Containment Temperature (Sheets 1 – 2) .....	3D-57
3D.5-9	MSIV Compartment Response to MSLB (Short Term) (Sheet 1 of 2).....	3D-59
3D.5-9	MSIV Compartment Response to MSLB (Long Term) (Sheet 2 of 2).....	3D-60
3D.C-1	Histogram of Threshold Gamma Dose for Mechanical Damage to Elastomers, Plastics, and Encapsulation Compounds .....	3D-93
3D.D-1	Frequency Distribution of Activation Energies of Various Components/ Materials (EPRI Data).....	3D-102
3D.D-2	Frequency Distribution of Activation Energies of Various Components/ Materials (Westinghouse Data) .....	3D-103
3D.D-3	Not Used	
3E-1	High Energy Piping – Steam Generator System (Sheets 1 – 2).....	3E-3
3E-2	High Energy Piping – Normal Residual Heat Removal System.....	3E-7
3E-3	High Energy Piping – Reactor Coolant System (Sheets 1 – 2).....	3E-9
3E-4	High Energy Piping – Passive Core Cooling System (Sheets 1 – 2) .....	3E-13
3E-5	High Energy Piping – Chemical and Volume Control System (Sheets 1 – 2) .....	3E-17
3G.1-1	Nuclear Island Seismic Analysis Models .....	3G-24
3G.2-1	3D Finite Element Model of Coupled Shield and Auxiliary Building .....	3G-25
3G.2-2	3D Finite Element Model of Containment Internal Structures .....	3G-26
3G.2-3	3D Finite Element Model of Containment Outer Basemat (Dish).....	3G-27
3G.2-4	Steel Containment Vessel and Polar Crane Models .....	3G-28
3G.2-5A	Polar Crane Model Simplified Model .....	3G-29
3G.2-5B	Polar Crane Model Detailed Model.....	3G-30
3G.2-6	Reactor Coolant Loop Lumped-Mass Stick Model .....	3G-31
3G.2-7	Pressurizer Model.....	3G-32
3G.2-8	Core Makeup Tank Models.....	3G-33
3G.2-9	AP1000 Nuclear Island Solid-Shell Model (NI10) .....	3G-34
3G.2-10	Containment Internal Structure with the SCV, PC, Reactor Coolant Loop and Pressurizer .....	3G-35
3G.2-11	Soil Structure Interaction Model – NI20 Looking East .....	3G-36
3G.2-12	Coarse Model of Containment Internal Structures .....	3G-37

**LIST OF FIGURES (Cont.)**

<b><u>Figure No.</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
3G.2-13	Fine Mesh (NI05) Model of Auxiliary and Shield Building .....	3G-38
3G.2-14	NI05 Model of Containment Internal Structures .....	3G-39
3G.2-15	3D NI05 Refined Mesh Model of Outer Containment Basemat (Dish) .....	3G-40
3G.2-16	Quadrant Model of Shield Building Roof .....	3G-41
3G.2-17	Detailed 3D Finite Element Model of Containment Vessel Including Large Penetrations .....	3G-42
3G.2-18	Axisymmetric Model of Containment Vessel.....	3G-43
3G.2-19	Schematic of Non-linear 2D East-West Nuclear Island Stick Model Used for Stability Evaluation that Addresses Sliding and Overturning .....	3G-44
3G.3-1	Generic Soil Profiles .....	3G-45
3G.3-2	2D SASSI FRS – Node 41 X (ASB El. 99') .....	3G-46
3G.3-3	2D SASSI FRS – Node 41 Y (ASB El. 99') .....	3G-47
3G.3-4	2D SASSI FRS – Node 120 X (ASB El. 179.6') .....	3G-48
3G.3-5	2D SASSI FRS – Node 120 Y (ASB El. 179.6') .....	3G-49
3G.3-6	2D SASSI FRS – Node 310 X (ASB El. 333.2') .....	3G-50
3G.3-7	2D SASSI FRS – Node 310 Y (ASB El. 333.2') .....	3G-51
3G.3-8	2D SASSI FRS – Node 411 X (SCV El. 200.0') .....	3G-52
3G.3-9	2D SASSI FRS – Node 411 Y (SCV El. 200.0') .....	3G-53
3G.3-10	2D SASSI FRS – Node 535 X (CIS El. 134.3') .....	3G-54
3G.3-11	2D SASSI FRS – Node 535 Y (CIS El. 134.3') .....	3G-55
3G.4-1	Auxiliary Shield Building “Rigid” Nodes at El. 135'.....	3G-56
3G.4-2	Auxiliary Shield Building “Flexible” Nodes at El. 135'.....	3G-57
3G.4-3	Excavated Soil.....	3G-58
3G.4-4	Additional Elements for Soil Pressure Calculations.....	3G-59
3G.4-5X	X Direction FRS for Node 130401 (NI10) or 1761 (N120) CIS at Reactor Vessel Support Elevation of 100'.....	3G-60
3G.4-5Y	Y Direction FRS for Node 130401 (NI10) or 1761 (N120) CIS at Reactor Vessel Support Elevation of 100'.....	3G-61
3G.4-5Z	Z Direction FRS for Node 130401 (NI10) or 1761 (N120) CIS at Reactor Vessel Support Elevation of 100'.....	3G-62
3G.4-6X	X Direction FRS for Node 105772 (NI10) or 2199 (N120) CIS at Operating Deck Elevation 134.25' .....	3G-63
3G.4-6Y	Y Direction FRS for Node 105772 (NI10) or 2199 (N120) CIS at Operating Deck Elevation 134.25' .....	3G-64
3G.4-6Z	Z Direction FRS for Node 105772 (NI10) or 2199 (N120) CIS at Operating Deck Elevation 134.25' .....	3G-65
3G.4-7X	X Direction FRS for Node 4724 (NI10) or 2078 (N120) ASB Control Room Side Elevation 116.50' .....	3G-66
3G.4-7Y	Y Direction FRS for Node 4724 (NI10) or 2078 (N120) ASB Control Room Side Elevation 116.50' .....	3G-67
3G.4-7Z	Z Direction FRS for Node 4724 (NI10) or 2078 (N120) ASB Control Room Side Elevation 116.50' .....	3G-68

**LIST OF FIGURES (Cont.)**

<b><u>Figure No.</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
3G.4-8X	X Direction FRS for Node 5754 (NI10) or 2675 (N120) ASB Fuel Building Roof Elevation 179.19'	3G-69
3G.4-8Y	Y Direction FRS for Node 5754 (NI10) or 2675 (N120) ASB Fuel Building Roof Elevation 179.19'	3G-70
3G.4-8Z	Z Direction FRS for Node 5754 (NI10) or 2675 (N120) ASB Fuel Building Roof Elevation 179.19'	3G-71
3G.4-9X	X Direction FRS for Node 8573 (NI10) or 3329 (N120) ASB Shield Building Roof Elevation 327.41'	3G-72
3G.4-9Y	Y Direction FRS for Node 8573 (NI10) or 3329 (N120) ASB Shield Building Roof Elevation 327.41'	3G-73
3G.4-9Z	Z Direction FRS for Node 8573 (NI10) or 3329 (N120) ASB Shield Building Roof Elevation 327.41'	3G-74
3G.4-10X	X Direction FRS for Node 130412 (NI10) or 2788 (N120) SCV Near Polar Crane Elevation 224.00'	3G-75
3G.4-10Y	Y Direction FRS for Node 130412 (NI10) or 2788 (N120) SCV Near Polar Crane Elevation 224.00'	3G-76
3G.4-10Z	Z Direction FRS for Node 130412 (NI10) or 2788 (N120) SCV Near Polar Crane Elevation 224.00'	3G-77
3H.2-1	General Layout of Auxiliary Building	3H-51
3H.5-1	Nuclear Island Critical Sections Plan at El. 135'-3 (Sheet 1)	3H-52
3H.5-1	Nuclear Island Critical Sections Plan at El. 180'-0" (Sheet 2)	3H-53
3H.5-1	Nuclear Island Critical Sections Plan Section A-A (Sheet 3)	3H-55
3H.5-2	Wall on Column Line 1 (Sheet 1)	3H-57
3H.5-2	Wall on Column Line 7.3 (Sheet 2)	3H-58
3H.5-2	Wall on Column Line L (Sheet 3)	3H-59
3H.5-3	Typical Reinforcement in Wall on Column Line 1	3H-60
3H.5-4	Typical Reinforcement in Wall 7.3	3H-61
3H.5-5	Concrete Reinforcement in Wall 11 (Sheet 1)	3H-62
3H.5-5	Concrete Reinforcement Layers in Wall 11 (Looking East) (Sheet 2)	3H-63
3H.5-5	Wall 11 at Main Steamline Anchor Section A-A (Sheet 3)	3H-64
3H.5-6	Auxiliary Building Typical Composite Floor	3H-65
3H.5-7	Typical Reinforcement and Connection to Shield Building	3H-67
3H.5-8	Auxiliary Building Operations Work Area (Tagging Room) Ceiling	3H-69
3H.5-9	Auxiliary Building Finned Floor (Sheets 1 – 3)	3H-71
3H.5-10	Spent Fuel Pool Wall Divider Wall Element Locations	3H-74
3H.5-11	Design of Shield Building: Roof and Air Inlets (Sheet 1)	3H-75
3H.5-11	Design of Shield Building: Concrete Detail at Tension Ring (Sheet 2)	3H-77
3H.5-11	Design of Shield Building: Roof/Air Inlet Interface (Sheet 3)	3H-78
3H.5-11	Design of Shield Building at Air Inlets (Sheet 4)	3H-79
3H.5-11	Design of Shield Building: Tank/Roof Interface Reinforcement (Sheet 5)	3H-80
3H.5-11	Design of Shield Building: Tank/Compression Ring Roof Interface Reinforcement (Sheet 6)	3H-81

**LIST OF FIGURES (Cont.)**

<b><u>Figure No.</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
3H.5-12	Typical Reinforcement in Wall L.....	3H-82
3H.5-13	Enhanced Shield Building Wall Panel Layout .....	3H-83
3H.5-14	Elevation View of Tension Ring and Air Inlets .....	3H-84
3H.5-15	Shield Building Tension Ring .....	3H-85
3H.5-16	Design of Shield Building: Surface Plates on Cylindrical Section – Developed View 90-270 Degrees (Sheet 1) .....	3H-86
3H.5-16	Design of Shield Building: Surface Plates on Cylindrical Section – Developed View 270-90 Degrees (Sheet 2) .....	3H-87
3I.1-1	Comparison of Horizontal AP1000 CSDRS and HRHF Envelope Response Spectra.....	3I-72
3I.1-2	Comparison of Vertical AP1000 CSDRS and HRHF Envelope Response Spectra .....	3I-73